High Technology Buildings

Characterized by large base-loads operating 24 hours a day with energy intensities much larger than typical commercial buildings, high-tech buildings include laboratories, cleanrooms, and data centers. An integrated design and build approach has the potential to reduce energy use in these buildings 30 to 50 percent.

California laboratory-type facilities alone use 111 trillion BTU of energy each year, including 8.8 billion kilowatt-hours of electricity (equivalent to 2,100 megawatts of peak electrical power) and 21 TBTU of natural gas, at a cost of $700 million—the potential savings from advanced design and technology in these buildings are huge.

EETD's high-tech buildings program conducts research on technologies and design, and works with partners such as the U.S. Department of Energy, U.S. Environmental Protection Agency, and the California Energy Commission on field tests and deployment programs. It has investigated and developed such technologies as DC-powered data centers, high-performance fume hoods, efficient power supplies, efficient fan units, and mini-environments for cleanrooms. It has also developed laboratory and data center energy benchmarking tools to identify energy waste and efficiency targets.

http://hightech.lbl.gov

Building Technologies

Cool Roofing Materials and Urban Heat Islands

Cities are urban heat islands, zones of higher temperature relative to the surrounding countryside. The heat island effect intensifies the use of expensive air conditioning. Higher outdoor air temperatures also increase smog formation. Division researchers have pioneered an effective, simple approach to keeping cities cooler—the use of shade trees and solar reflective roofing and paving materials. EETD studies have found that the cooling effect from wide application of these measures could save billions of dollars and reduce smog in large cities nationwide.

A program to develop cool-colored roofing materials in cooperation with the roofing industry has resulted in an entire class of new products now in the marketplace: cool, solar-reflective metal, clay, concrete tiles, and asphalt shingles that reduce air conditioning energy use by up to 20 percent by reflecting more of the sun's heat back to space.

http://coolcolors.lbl.gov/
http://heatisland.lbl.gov

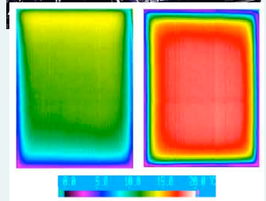
Distributed Energy Resources and Energy Storage

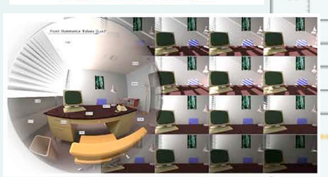
Distributed energy resources (DER) are technologies that provide energy close to the energy consumer; for example, small power generators including renewable sources, energy storage units, interconnection and power control technologies, and combined heat and power technologies. DER could help buildings become net-zero energy users. EETD researchers are developing methods and tools for assessing the use of DER by customers operating as a microgrid, a group of energy sources and users that are connected to the larger electricity grid, but can function independently of it. Researchers have developed a customer adoption model (DER-CAM) for on-site electricity and heat requirements that helps customers develop an optimal plan to meet their energy need at minimum cost over a test period. They are also testing the microgrid concept in cooperation with utility and commercial partners.

http://eetd.lbl.gov/EA/EMP/der.html
http://der.lbl.gov

February, 2011

Windows, Daylighting, and Lighting Controls





Every year, heat worth billions of dollars flows through windows in American homes and businesses. In hot climates, the heat radiates into homes, requiring expensive air conditioning. In cold climates, it leaks out, requiring more energy to keep the occupants warm. Thermally efficient windows save consumers and businesses energy and money.

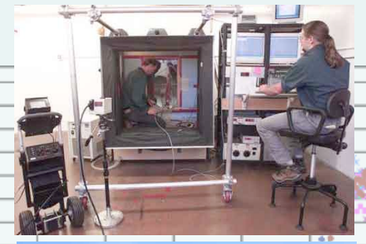
EETD's researchers develop advanced optical coatings and materials for future windows; study the energy performance of windows and window systems (windows, glazings, and their frames, blinds, louvers, etc.); and create computer tools to improve window energy performance and support product rating and labeling.

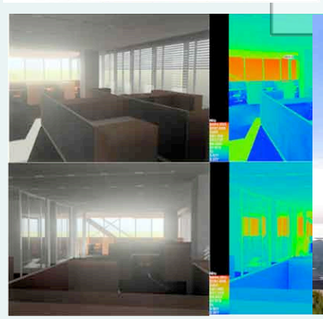
EETD's infrared thermography lab is used to study the thermal and insulating properties of new windows, materials, and building envelope systems.

Advanced daylighting designs allow natural light to be used effectively, reducing the need for electric lighting. Optimal use of natural daylight requires advanced lighting controls that sense light levels and occupancy.

A unique lab whose construction was funded by the California Energy Commission's Public Interest Energy Research, the Advanced Windows Test Facility serves as the primary test facility for prototype systems such as electrochromic windows, automated motorized blinds, and advanced controls for these systems.

http://windows.lbl.gov





Modeling and Simulation of Building Energy and Control Systems

To achieve the next leap in building energy efficiency, buildings will need to integrate information from air-conditioning systems, lighting systems, and the electrical grid to regulate their operation to optimize occupant comfort, energy use, and peak power demand. Scientists in the Simulation Research Group, and their colleagues at UC Berkeley are developing software that will allow building scientists and designers to use virtual prototyping to explore and optimize new system-level solutions for space conditioning and to develop and assess the performance of control systems that minimize environmental impact while maintaining occupant comfort. This same software, used as part of the building control system, will allow operators to maximize efficiency and monitoring the operation of their building.

EETD scientists are integrating through the Building Controls Virtual Test Bed various software environments, such as the next-generation open-source modeling language Modelica; the University of California (UC), Berkeley-developed modeling environment Ptolemy II; and EETD-developed software such as EnergyPlus and Radiance. These programs can then be used for integrated design studies as well as model-based operation when linked to BACnet compatible building control systems.

EnergyPlus

EnergyPlus is an advanced computer program that simulates hourly building energy use. This program is an international benchmark and is used as the basis of building standards in the U.S. and other countries. EnergyPlus combines the best features of the DOE-2 and BLAST programs into a new, powerful, and more accurate program.

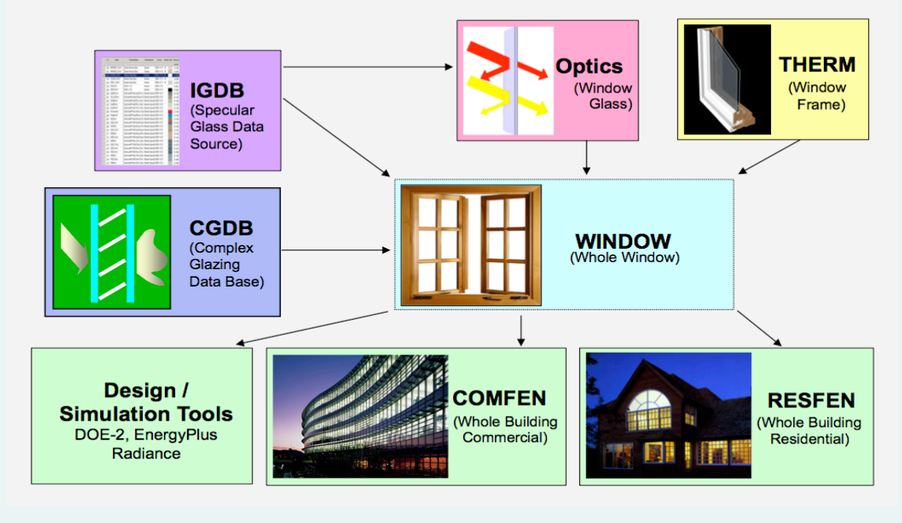
EnergyPlus features a heat balance loads calculation, a simultaneous loads and HVAC calculation, sub-hour time steps, moisture absorption/desorption in building elements, loop-based HVAC systems, a new input data structure that allows easy attachment of graphical user interfaces, a modularized code that allows others to easily add new calculation features, and a new output data structure that allows easy attachment of post-processors for results display and analysis.

http://apps1.eere.energy.gov/buildings/energyplus/
http://gundog.lbl.gov/EP/ep_main.html

Home Energy Saver

Home Energy Saver is the first Internet-based tool for calculating energy use in residential buildings. The project is sponsored by the U.S. Environmental Protection Agency and the U.S. Department of Energy as part of their national ENERGY STAR programs for improving energy efficiency in homes.

http://hes.lbl.gov/



COMFEN

COMFEN is a tool designed to support the systematic evaluation of alternative fenestration systems for project-specific commercial building applications. COMFEN provides a simplified Excel-based user interface that focuses attention on key variables in fenestration design. Under the hood is EnergyPlus, a sophisticated analysis engine that dynamically simulates the effects of these key fenestration variables on energy consumption, peak energy demand, and thermal and visual comfort.

The results from the EnergyPlus simulation are presented in graphical and tabular format within the simplified user interface for up to four comparative fenestration design cases, to help users move toward optimal fenestration design choices for their project.

http://windows.lbl.gov/software/comfen/2/

RESFEN

RESFEN (RESidential FENestration) is a program for calculating the annual heating and cooling energy use and costs attributable to fenestration systems in residential buildings. RESFEN also calculates their contribution to peak heating and cooling loads.

http://windows.lbl.gov/software/resfen/resfen.html

RADIANCE

RADIANCE is a photometrically accurate computer-generated graphic simulation of lighting in indoor environments. The ultra-realistic images produced by the program facilitate the designer's visualization of lighting design options.

http://radsite.lbl.gov/radiance/home.html

WINDOW

WINDOW is a window thermal analysis computer program that is the de facto standard used by U.S. manufacturers to characterize product performance. The program has been selected by the newly formed National Fenestration Rating Council as the basis for development of energy rating labels for windows.

http://windows.lbl.gov/software/window/window.html